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SUBJECT Comments and Evaluations on Seven USSR Articles on Technology, Materials, and Aluminum Alloys

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1. Introduction of New Technology by N Lutay. Za Ekonomiyu Materialov (1953) no. 4, pp 61/63

   a. I the manufacture of machines, the cos of the metal amounts to 50/60% of the c t of the finished product so any possible economy in this field is important. Close cooperation among technical personnel and workers at the plant where Lutay works has permitted a number of economies, which have increased the coefficient of utilization of hot-rolled steel to 0.80/0.83. Cheaper material has been substituted for more expensive; simple forms for more complicated ones; and cast material for rolled. A number of examples, mainly parts of self-propelled harvesters, are discussed in general terms. In most cases weight of the finished part has been decreased as well as cost. Special measures have been taken to economize in the use of nonferrous products; for instance, brass sheet has replaced bronze castings. Particular emphasis has been placed on improved

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More extensive work has been done on the use of oxygen in Europe, where a low-shaft furnace with oxygen or oxygen-enriched blast seems to have more commercial possibilities.

O R Rice: The Blast-Furnace Situation in the United States. JISI 170 (1952) pp 89/108

e. Although Bardin feels the use of oxygen should be most advantageous in blast furnaces where the greatest amount of oxygen is used, there is considerable reason to doubt the validity of this conclusion. Precisely because large amounts of oxygen are involved, cheap sources of mass producing this oxygen must be provided. Also, as Bardin indicates, it seems that a change - probably radical - in blast-furnace design is necessary to take full advantage of the oxygen. On the other hand, relatively less oxygen is needed for steel making and, in general, few if any modifications in furnace design are required to profit from the oxygen. Therefore, the use of oxygen in steel making has been more appealing in the USA where it is used to a significant extent today in basic-open-hearth practice (mentioned vaguely by Bardin) and in electric-furnace steel melting (not mentioned by Bardin). In Europe there has been some use of oxygen in converter melting, where the results in general seem to be similar to those obtained by Bardin.

f. Of the other projects on "new and little developed" processes mentioned by Bardin:

1) Direct reduction of ore (presumably iron ore) has fascinated metallurgists for many years, but, except for very special cases, a process has not yet been found that can compete economically with the blast furnace. Even the widely publicized "Krupp Rennfeuer" process did not produce steel directly but was applied almost entirely in the production of an intermediate product that had to be subsequently melted.

2) Replacement of coke with electric energy and a cheaper reducing agent is, of course, of major interest only where electricity is plentiful while coking coal is not. There has been little done in this field in the USA, although there has been a limited development in Scandinavia and Switzerland.

3) Continuous casting and rolling have been commercial for some time for nonferrous products. This process has been applied successfully to steel on a semicommercial basis only relatively recently in the USA.

There is no indication as to what actual development work - if any - had been done in the USSR on these projects at the time this paper was written.

3. Saving Material by Decreasing Machining Allowances by V Kovan. Za Ekonomiyu Materialov (1953) no. 4, pp 17/23

a. Large amounts of material are wasted by use of generalized allowance tables as these do not take into account many of the variables that should affect these figures. Allowances may be excessive even when they are determined individually for specific parts. Kovan, who has long worked on the theoretical basis for machining allowances, and his colleagues recently issued a new system of allowances, which is based on three main factors:

1) the effect of size, form and position of the surface being machined, on the defects formed in various processes;

2) the "law" of duplication of defects, whereby defects from one operation are duplicated, but to a decreasing degree, in subsequent operations;

3) the need in each operation to eliminate defects from previous operations.

Various factors affecting these items as well as the interrelation of allowances and tolerances are discussed in very general terms. A significant conclusion is considered to be the fact that the allowances for each operation depend mainly

layouts to conserve materials. At present development is being concentrated on mechanization of layo ts, which should give still further economies.

b. The weight saving mentioned in many of the examples is interesting. In the USA many producers of farm equipment consider weight saving is not especially important in this field since a certain minimum weight is needed for proper operation.

c. Except in the case of the layouts, there are insufficient details to permit evaluation of previous practice. On the whole, the changes seem to have been logical and in line with good engineering practice. One interesting facet is the fact that these changes were made on old models in production as well as on new designs.

d. The original layout was extremely wasteful, unless some use was made of the large pieces of scrap generated. No mention is made of such a practice although it is fairly common in the USA.

e. This paper, as well as some others from about this period, indicate increasing use of castings as a replacement for wrought products. It is not clear, however, as to whether inadequate rolling mill capacity has been a factor, nor whether this is a general trend in industry. There is also the possibility that less transportation might be involved with castings as they could be produced in small foundries in or near to the plant, while rolled products might have to be shipped a considerable distance from the nearest rolling mill.

2. Oxygen Blast - A New Step in Metallurgical Development by I P Bardin. Izvestiya Akademii Nauk SSSR (1947) no. 10, pp 1363/1368

a. A rather rambling, flagwaving paper devoted mainly to the use of oxygen in the blast furnace, a field of investigation that has been guided by Bardin for the past few years. Application of oxygen to steel melting is treated only briefly. Bardin places considerable emphasis on the need for basic research and new processing methods.

b. The article is vague in many respects; perhaps more specific details are given in reference 2. Among the major items not clarified here:

1) Is the work on blast furnaces confined to furnaces with conventional design, or to low-shaft furnaces, or are both included?

2) Is the aim to use a 100% oxygen blast, or merely enriched air?

3) Just what was the status of the use of oxygen in the blast furnace in 1947? Apparently, the five-year plan then in force covered "preparations" for the use of oxygen in commercial blast furnaces to melt all kinds of pig iron, but this could mean almost anything.

c. Bardin claims that no other country has carried out development work on the use of oxygen in metallurgy on such a massive scale as has the USSR. This statement was probably correct in 1947, but may not be so today.

d. As far as the use of oxygen in the blast furnace is concerned, relatively little work has been done in the USA. Rice indicates that a limited series of tests showed oxygen enrichment of the blast had about the same effect as increasing the blast temperature. These luke-warm results would explain why more attention has been paid to other, more promising changes in blast-furnace practice - such as beneficiation of raw materials, improved refractories and high top-pressure.

on the defects from the previous operation. A practical evaluation of the system at the Stalin Automotive Plant in Moscow showed a decrease of 10 to 30% in the amount of material lost as chips. The new method can be used to save material, improve quality and evaluate old and new processing methods.

b. According to Kovan, the weight of finished machine parts usually amounts to only 60/70% of the rough weight. In only a few of the more advanced plants is the recovery increased to 75/80%. The rest of the raw material is lost in the form of chips. Without further details on the types of parts involved, and just what stage "rough" represents, it is impossible to evaluate these figures. It is evident, however, that the differences in recovery figures among various plants might be the result of the type of parts being made rather than of the degree of advancement of the technical management of the plant.

c. The new system would seem to be a most elaborate one, particularly if it takes into detailed account all the factors said to be involved. There is some question as to the economic justification for such a system. From this general paper, it is not possible to judge the novelty of the new system.

d. Apparently Kovan's only aim is to decrease allowances. He does not mention specifically such processes as investment casting, die casting and powder metallurgy that may reduce machining allowances markedly or even eliminate machining entirely. Kovan seems to pay no attention to the fact that machining may be the cheapest method of bringing a part to finished size. For instance, it may be more economical to start with a less precise sand casting and machine to finished size and form than to use a die casting that is closer to finished size. Also he does not seem to take into account the number of parts required. For a relatively small total production, it is seldom economical or feasible to work to the smallest possible allowances. As the estimated total production increases, it becomes more desirable to consider such factors.

4. On the Development of the Production of Substitutes for Nonferrous Metals by I K Klinov. Za Ekonomiyu Materialov (1953) no. 4, pp 30/37

a. The 1951/1955 five-year plan provides for the development of corrosion-resistant, synthetic, organic constructional materials as a substitute for nonferrous metals and alloy steels. The need for substitutes is particularly important at present in the case of lead, which is widely used in many different industries for corrosion-resistant purposes. Among the possible substitutes are polyisobutylene (Vistanex in the USA?), asbestos-vinyl plastics, impregnated graphite and vinyl plastics. The production of the first three of these has been developed on a commercial scale in the USSR in the past two to three years, while the last has been made for a longer period. In some applications the substitute materials can be used for structural purposes, but in other cases they are suitable only for coatings or linings of ferrous equipment.

b. Despite the emphasis on the need to replace lead, it seems to have been used in many applications where corrosion-resistant steels or other nonferrous alloys would have been first choice in the USA. Perhaps this is an indication that the alloying elements in the latter materials (such as molybdenum and nickel) have been less available than lead in the USSR.

c. I am not competent to evaluate the properties of the plastics, which are discussed by Klinov.

5. A Weak Struggle for Material Economy by A Maksimov. Za Ekonomiyu Materialov (1953) no. 4, pp 78/80

a. A nonmetallurgical paper giving a slightly sour report on the material-technical supply department of the former Ministry of the Automotive and Tractor Industry. Although its organization is said to have improved somewhat, there are still deficiencies. Various cases are cited of excessive shipments to individual plants and of misuse of this material. Part of the difficulty lies in improper control and guidance by the supply departments of the plants themselves, and part in poor paper work at the main supply department.

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b. Perhaps the moral is that an organization as large as this ministry should decentralize its "purchasing departments", but this possible solution to the problem is not mentioned.

6. Strengthening the Control of Utilization of Material Resources by Ya Ryabov. Za Ekonomiyu Materialov (1953) no. 4, pp 83/85

a. A nonmetallurgical paper dealing in general terms with the shortcomings of the Glavsnab, or central supply department, of the former Ministry of Transport Machinery. Programming, planning and control of supplies were inadequate. A few examples are given where individual plants squandered "excess" material that had been sent them. In other cases, supplies were so low that expensive methods of shipment, such as by air, had to be used to avoid interruptions in production. In the first half year of 1952, the "overnormal" stocks of materials in the ministry as a whole increased by some "tens of millions of rubles". It is expected that needed improvements in the work of this department will be facilitated by its current reorganizations.

b. In some at least of the horrible examples cited, it seems quite possible that the plant manager may have used the more expensive, "excess" material only because the specified material was not available and he had to meet his quota.

7. Effect of Composition and Structure on the Elevated-Temperature Strength of Aluminum Alloys by A A Bochvar. Izvestiya Akademii Nauk SSSR (1947) no. 10, pp 1369/1384

a. The amount of experimentation that can be done with conventional creep tests is limited by the length of time needed to conduct the tests. Short-time tensile tests have not proved a satisfactory alternate as they may rank materials in a different order from that based on long-time creep tests. A new method is therefore proposed. It is based on the change in hot hardness (measured after removal of the load) with increasing indentation time. The material being tested is stabilized by holding at test temperature for about 100 hr before testing.

1) Macrohardness tests were run on a series of cast aluminum alloys. Most of the tests were made at 570, 660 and 750 F, with indentation times from 10 sec to 60 min. A few tests were made at 390 F. The results were in good agreement with the information obtained in long-time creep tests (creep data not given).

2) Microhardness tests were made on a series of cast alloys with 5/12% Cu (half were as-cast; half were heat treated). Tests were made at 480 and 660 F, but results are given only for the latter temperature.

3) Factors affecting the elevated-temperature strength of aluminum alloys at various temperatures are discussed, and a hypothesis proposed as to the type of structure that should be most satisfactory in each case. In the search for new aluminum alloys suitable for use at temperatures over 480/570 F, work on single-phase solid-solution alloys should be dropped. A more promising line of investigation appears to be heterogeneous alloys with a network or skeleton of a second phase. Cast alloys should give better properties than wrought. It should, however, be borne in mind that elevated-temperature strength is not always the only requirement.

b. On the basis of these results, it is believed that this new method is satisfactory for aluminum alloys at temperatures over about 480/570 F and may find application with steel and other alloys. It is not expected that this test will replace creep tests, but that it will serve as a screening test and for extensive experimental work where numerous variables are involved. The new test will probably not be satisfactory at lower temperatures where speed of recovery and work hardening are involved.

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c. As far as is known, this particular type of hardness test has not been applied to aluminum alloys. Bochvar discusses the probable reasons for the poor results obtained by previous investigators who used a single hot-hardness test. Mirkin and Livshits, however, have successfully applied a modification of Bochvar's hot-hardness test to iron-base, nickel-base, cobalt-base and chromium-base alloys. Miller of The Babcock and Wilcox Co tried the Mirkin-Livshits method on various high-temperature alloys and obtained "a remarkable correlation" between the results of this test and corresponding creep and stress-rupture tests. Miller feels the method may eventually lend itself to the screening of high-temperature alloys.

> I L Mirkin and D E Livshits: <u>Method of Determining Hardness at High Temperatures.</u> Zavodskaya Laboratoriya 15 (1949) pp 1080/1087
>
> P C Miller: discussion of F Garofalo, P R Malenock and G V Smith: <u>Hardness of Various Steels at Elevated Temperatures.</u> TASM 45 (1953) pp 377/394; disc 394/396

d. Although Bochvar states that short-time tensile tests have proved unsatisfactory, he was apparently referring to tensile tests conducted at the same temperature as the creep tests. Robinson, Tietz and Dorn have recently indicated that they feel short-time tensile tests can be employed for preliminary evaluation of the creep strength of aluminum alloys provided the tensile tests are made at a higher temperature.

> A T Robinson, T E Tietz and J E Dorn: <u>The Functions of Alloying Elements in the Creep Resistance of Alpha Solid Solutions of Aluminum.</u> TASM 44 (1952) pp 896/928

e. On the basis of Bochvar's preliminary tests, the advantages of microhardness tests over the simpler macrohardness tests are not evident. It is possible, however, that microhardness tests might prove more instructive in some cases.

f. Only a relatively limited amount of information has been published in the USA or in Great Britain on the creep characteristics of aluminum-alloy castings. In general, this work has been limited to temperatures up to 400 F. The 142 type (ASTM CN42A) has not shown exceptional properties in this temperature range, although the corresponding AL 1 tested by Bochvar gave the best strength at temperature of all the alloys included in the first series of tests.

> J McKeown and R D S Lushey: <u>Creep Properties of Some Aluminium Alloys at Temperatures up to 300° C.</u> Metallurgia 43 (1951) pp 15/19
>
> O D Sherby, T E Tietz and J E Dorn: <u>The Creep Properties of Some Forged and Cast Aluminum Alloys.</u> Proc ASTM 51 (1951) pp 964/976; disc 977/980
>
> O D Sherby and J E Dorn: <u>The Creep Properties of Sand-Cast Aluminum Materials 319-T71, 319-F, and 356-T7.</u> Proc ASTM 52 (1952) pp 890/902; disc 902/904

g. The creep strength of aluminum and its alloys generally decreases fairly rapidly at temperatures above 400 F; therefore, it is not too clear why apparently extensive tests were made in the USSR at higher temperatures. The decrease in strength of aluminum at such temperatures is one reason why so much emphasis has been placed on titanium in the USA, as titanium is markedly superior to aluminum at these temperatures, which may be encountered, for example, in the aerodynamic surfaces of supersonic aircraft. The fact that the present investigation was limited to cast alloys, however, would seem to exclude such types of applications.

h. Parts of Bochvar's hypothesis appear questionable but insufficient evidence is available to evaluate it either in respect to aluminum alloys or other materials.

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615.02	N
662.3	N
615.916	N
615.915	N
615.925	N
103.642	N
103.686	N
615.14	N
615.511	N
615.13	N